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# Aberdeen Proving Ground

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## DEVELOPMENT AND PROOF SERVICES

1st Report

OCO Project No. 15-1 1

ARMY OS ABERDEEN PROVING GROUND MD 415

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A TEST COMPARING THE 105MM CARTRIDGE, T119E12 AND THE  
105MM CARTRIDGE, T184E13 UNDER WINTER ARCTIC CONDITIONS

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CLIMATIC TEST DIVISION  
ABERDEEN PROVING GROUND,  
MARYLAND

Mr Engelhardt/mp/5233  
13 May 1954

Authority : ORDTA

DA Priority: 1A

A TEST COMPARING THE 105mm CARTRIDGE, T119E12  
AND THE 105mm CARTRIDGE, T184E13 UNDER WINTER  
ARCTIC CONDITIONS AT FORT CHURCHILL, MANITOBA,  
CANADA.

FIRST REPORT ON PROJECT NO. TA1-1536

113RD REPORT ON PROJECT NO. TB5-1401

DATES OF TEST: 13 February to 22 February 1954

OBJECT

To compare the accuracy and ignition characteristics of the T119E12 and T184E13 rounds under winter arctic conditions.

SUMMARY

The two types of subject rounds were tested for accuracy at 1000 yards and 1500 yards at temperatures down to -26°F with satisfactory results. The T184E13 round was observed to have several material defects which could restrict its use at low temperatures.

CONCLUSIONS

It is concluded that the accuracy of the 105mm Cartridge, T119E12 is satisfactory at 1000 yards at temperatures down to -26°F. It is concluded that the accuracy of the 105mm Cartridge T184E13 is satisfactory at 1000 yards and 1500 yards at temperatures down to -20°F. The durability of the positioning ring and the liner on the T184E13 round is unsatisfactory.

RECOMMENDATIONS

It is recommended that the accuracy of the 105mm Cartridge, T119E12 be considered satisfactory at 1000 yards at temperatures down to -26°F and that the accuracy of the 105mm Cartridge, T184E13 be considered satisfactory at ranges of 1000 and 1500 yards at temperatures down to -20°F. It is recommended that improvements be made in the liner and positioning ring used on the T184E13 cartridge in order to enable them to withstand normal handling procedures at low temperatures.

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## I. INTRODUCTION

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### A. DISCUSSION

Extensive tests have been conducted on both the T119E12 and the T184E13 rounds at Aberdeen Proving Ground with respect to accuracy. The majority of these tests have been conducted in the 70° temperature range and both rounds appeared to have satisfactory accuracy characteristics. It was desired to investigate these two rounds under winter arctic conditions in order to determine, if any, the effect of this particular type of environment on the velocity and stability of both types of rounds.

The T119E11 round differs from the T119E12 round in that the T119E12 round has a counterbore on the base end of the cartridge case to accommodate the breech on the M27 rifle. In previous tests at Aberdeen Proving Ground, it was discovered that the mechanism driving the fins outward on the T119E11 round would not function properly at -40°F. This resulted in a very erratic flight of the projectile. To combat this deficiency, the rounds were modified by increasing the clearance between the piston and the piston stop interference ring and reducing the shear ring cross-sectional area. This modified T119E12 round was the type used for the tests included in this report.

The T184 type round was originally developed for the 105mm, M27 rifle. However, in the early part of 1952, the T170 type rifle was developed which had the M27 tube and a smaller chamber similar to that of a previous rifle, the T136. When the T184 type projectiles first employing an end plate were used in the M27 rifle, they became known as the T184E5; in the T170 rifle, as the T184E6. Later both the M27 and the T170 rifles were counterbored at the origin of the rifling to permit the use of the T119 type of projectile. The T184 type rounds which were used in the counterbored M27 and T170 rifles became known as the T184E13 and the T184E12 respectively.

The T119 type round which has folding fins was developed by the Firestone Tire and Rubber Company for use in a smoothbore tube. The smoothbore tube was discarded and through successive modifications the round was developed for use in the counterbored M27 rifle and the counterbored T170 rifle which is designated as the T170E1 and is used in the BAT system. The round when used in the M27 rifle is known as the T119E12 and as the T119E11 when used in the T170E1 rifle.

### B. REFERENCES

#### 1. Authority for test (copy attached as appendix A)

a. Letter file OO 400.112/2772, APG 400.112/1496, dated 25 August 1953, Subject: "Proposed Ordnance Environmental Tests Winter 1953-54, Fort Churchill, Manitoba, Canada, and Flin Flon, Canada".

#### 2. Technical References

a. Development and Proof Services Firing Record No. P55424

b. Progress Reports of Firestone Tire and Rubber Company on Battalion Anti-tank Project, Ordnance Department Project No. T41-1540 (Ammunition), T54-4020 (Weapons and Accessories)

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c. Frankford Arsenal Report - Status reports on Battalion Anti-tank Weapons and Ammunition, Project TS4-4020, TAI-1540, and TAI-1536.

### II DESCRIPTION OF MATERIEL

#### A. 105mm CARTRIDGE, HEAT, T119E12

The Cartridge, HEAT, T119E12 is a non-rotated round which obtains its stability from six aluminum folding fins. Upon ignition, the fins are forced into their normal flight position by a piston operated by the propelling gases. This piston is located in the rear of the round and operated on a pressure differential basis which prevents actuation of the piston until the round has cleared the tube. The piston is held in its final position by a knurled interference ring which in turn keeps the fins in their flight position. This round employs a conventional crimp at the mouth of the cartridge case and uses a polyethylene and rayon liner. The propellant is placed in the round by means of a plug which screws into the base of the cartridge case.

#### B. 105mm CARTRIDGE, HEAT, T184E13

The 105mm cartridge, HEAT, T184E13 is also a non-rotated round which obtains its stability through the use of six fixed aluminum fins which have an outer diameter slightly less than the caliber diameter. These fins have an end plate and are connected to the projectile by means of a boom which also contains the ignition cartridge. The projectile is held to the case by the primer head which is screwed into a retainer attached to the case. The debulleting force is obtained by shearing the neck of the retainer. The round is held at the mouth of the case by a plastic positioning ring and it has an external nitrocellulose liner.

### III DETAILS OF TEST

#### A. PROCEDURE

1. An accuracy pattern was fired at a 1000 yard and a 1500 yard range with each type of ammunition. The procedure used was similar to that described in the Ordnance Proof Manual for accuracy firing.

2. The complete program was fired with the weapon mounted on the truck, 1/4-ton, M38, with the gunner sitting in the truck beside the gun in his normal firing position. The stability of the mount on the snow covered terrain was excellent. All velocity measurements were made with sky screens placed approximately 100 and 140 feet from the muzzle respectively. The Potter counter chronograph and the sky screens used an M5 portable generator as a power source.

3. The ammunition was removed from the boxcar and placed on sleds. The sleds were then towed by a tracklaying vehicle to the firing position which was a distance of approximately 10 miles, 7 of which was over unprepared roads. The ammunition crates were then stacked in the open for a period ranging up to two weeks before firing. The weather conditions during this storage period may be found in Appendix D.

4. All ammunition was inspected before firing and appropriate observations were made.

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## B. RESULTS

1. The results of the test are as follows:

	T119E12 1008 Yard Range	T119E12 1508 Yard Range	T184E13 1008 Yard Range	T184E13 1508 Yard Range
Number of rounds fired in accuracy pattern not including conditioning rounds.	16	16	18	15
Number of rounds which missed target in accuracy pattern not including conditioning rounds.	0	7	0	1
Probable Error*				
Vertical (MILS)	.333	.456	.387	.573
Lateral (MILS)	.257	.305	.453	.401
Average Velocity (FPS)	Lost	1548	1519	1516
Maximum Velocity Dispersion Between Rounds (FPS)		37	41	39

\*NOTE: These figures are not corrected for velocity.

2. No velocity data was obtained during the test of the T119E12 cartridge at the 1008 yard range because the skyscreens used for velocity measurements were not functioning properly.

3. Of the 40 rounds of T184E13 ammunition received for test, the liner was cracked on 11 of these rounds and had fallen away from the cartridge case on four rounds exposing 4 to 8 square inches of the perforations and allowing the propellant to spill out. Sixteen positioning rings were cracked and four (4) were shattered.

4. All of the T184E13 rounds produced a muzzle after burning flame of one half to two feet in length.

5. All cartridge cases and primers were in good condition after firing. All projectile flights appeared to be stable as observed through a BC scope. All ammunition with the exceptions mentioned in paragraph 3 above arrived in good condition.

6. Temperatures to which the rounds were subjected while in storage at the firing position may be found in Appendix D.

## C. OBSERVATIONS

1. No shattered positioning rings were damaged to the point that they could no longer support the projectile. The cracked positioning rings were still intact with all pieces still in place whereas the shattered rings were observed to have pieces which had broken off and fallen into the fiber shipping container. See APG Photograph No. A96306, Appendix F.

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2. The cracked liners were still adhered to the case and no pieces had fallen off. Four rounds had a liner which had cracked and had fallen completely away from the case allowing the propellant to spill out of the case perforations; however, care was taken when the rounds were handled prior to firing and very little propellant was lost.

3. The faulty liners and positioning rings did not appear to affect the performance of the round. Special attention was given to these rounds in order to minimize the effect of the defective parts, but under field conditions, the poor durability of the liners and conditioning rings could affect the round performance.

4. The transportation of the ammunition on sleds for a distance of 10 miles subjected the rounds to considerable jolting and bumping which could have influenced the malfunctions of the T184E13 liners and positioning rings.

5. It was not possible to fire the accuracy groups at the same range on the same day as requested in the test plan because the conditions under which the tests were conducted slowed firing and preparation procedures considerably in comparison to tests conducted under temperate conditions.

6. The firing handle on the M27 rifle was somewhat small for use with the arctic mitt. The gunner reported that the tight fit within the firing handle had a tendency to move the gun off of the aiming point in the event the gun was sighted before the firing handle was grasped. See APG Photograph A96304, Appendix F.

7. The seven rounds which missed the target while firing the T119E12 round at a 1508 yard range tend to make the probable error figures questionable. For this reason, no conclusions have been made on this round at this range. The reason for seven rounds missing the target is not known. All rounds passed over the target and for that reason the elevation of the tube as well as the method for laying the weapon were very carefully checked after two rounds had passed over the target. No discrepancies were noted.

8. The use of sky screens for taking velocity data is extremely advantageous in the arctic. It eliminated the use of the magnetizer which required constant protection to prevent snow from shorting out the electrical circuit. It also eliminated the use of velocity coils which are difficult to manipulate while wearing arctic gear.

9. It was found that all ammunition handling procedures could be easily accomplished while the crew was wearing arctic clothing.

10. The muzzle after burning flame of the T184E13 round did not endanger or hamper the operation of the gunner.

#### IV. CONCLUSIONS

It is concluded that:

A. The accuracy of the 105mm Cartridge, HEAT, T119E12 is satisfactory at a range of 1000 yards at temperatures down to -26°F.

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B. The accuracy of the 105mm Cartridge, HEAT, T184E13 is satisfactory at ranges of 1000 and 1500 yards at temperatures down to -20°F.

C. The velocity characteristics of both rounds are satisfactory down to temperatures of -20°F.

D. The durability of the liner and positioning ring used in the T184E13 cartridge is unsatisfactory when subjected to normal ammunition handling procedures at temperatures as low as -25°F.

V. RECOMMENDATIONS

It is recommended that:

A. The accuracy of the 105mm Cartridge, T119E12 be considered satisfactory at a 1000 yard range and temperatures down to -25°F.

B. The accuracy of the 105mm Cartridge, HEAT, T184E13 be considered satisfactory at ranges of 1000 and 1500 yards at temperatures down to -20°F.

C. A liner and positioning ring be developed for the T184E13 round that will withstand rough handling at low temperatures without failures.

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SUBMITTED BY:

*B. S. Goodwin*  
B. S. GOODWIN  
Chief, Arms & Ammunition Division  
Development and Proof Services

PREPARED BY:

*R. E. Engelhardt*  
R. E. ENGELHARDT  
Project Engineer  
Southwest Research Institute

APPROVED BY:

T. F. COLLERAN  
Director  
Development and Proof Services

REVIEWED BY:

*A. B. Duke*  
A. B. DUKE  
Lt Col, Ord Corps  
Chief, Climatic Test Division  
Development and Proof Services

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APPENDICES

- A. CORRESPONDENCE
- B. TEST PLAN
- C. FIRING RECORD
- D. DATA REDUCTION ANALYSIS
- E. WEATHER DATA
- F. ENVANAL RATING CHART
- G. PHOTOGRAPH

14. 40-12/193

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APPENDIX A

CORRESPONDENCE

1. Letter, file OO 400.112/2772, APG 400.112/1496  
dated 25 August 1953.

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OFFICE OF THE CHIEF OF ORDNANCE  
WASHINGTON, D. C.

25 August 1953

SUBJECT: Proposed Ordnance Environmental Tests Winter 1953-54,  
Fort Churchill, Manitoba, Canada, and Flin Flon, Canada

TO: Commanding General  
Aberdeen Proving Ground  
Maryland

Subject program has been approved by the Assistant Chief of  
Staff, G-4.

BY COMMAND OF MAJOR GENERAL FORD:

/s/ N. L. KLEIN  
Assistant

C O P Y

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APPENDIX B

TEST PLAN

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CLIMATIC TEST DIVISION  
DEVELOPMENT AND PROOF SERVICES  
ABERDEEN PROVING GROUND  
MARYLAND

TEST PLAN

Project: Winter Test Comparing 105mm Shell, T184E13 and 105mm Shell, T119E12 at Fort Churchill, Manitoba, Canada.

Project No.: 1st Report on Project TA1-1536  
143rd Report on Project TB5-1401

Project Engineer: R. E. Engelhardt

Priority: 1A

Authority: Letter dated 25 August 1953 OO 400.112/2772, APG 400.112/1496

Object of Test:

To compare the accuracy and ignition characteristics of the subject rounds under arctic conditions.

Background:

The 184E13 cartridge has been standardized and is in production. It has had limited firing at -40°F and no resulting deficiencies have been noted.

The T119E12 cartridge is also in the limited production stage; however, recent firings at -40°F at Aberdeen Proving Ground with the T119E11 cartridge which is very similar to the T119E12, resulted in a malfunction in the mechanism which drives the fins outward. As a result of these tests, the clearance between the piston and the piston stop interference ring has been increased and the shear ring cross-sectional area has been reduced. The modified rounds have yet to be proof fired by Aberdeen Proving Ground but these changes are expected to correct any cold weather deficiencies of the round.

Description of Materiel:

The 105mm Shell, T184E13 is a HEAT round having six fixed fins with an end plate. The fins are connected to the projectile by means of a boom which also contains the ignition cartridge. The projectile is supported at the mouth of the case by a positioning ring.

The 105mm Shell, T119E12 is a HEAT round which has six folding fins. Upon ignition the fins are pushed into their normal flight position by a gas operated piston contained in the round. However, this piston operates on a pressure differential basis and is held in the original position until the round is free of the tube, thus preventing an attempt of the fins to open while the round is still in the tube. The only difference between this round and the 106mm Shell, T119E11, is a counterbore on the base end of the T119E12 cartridge case.

Detailed Test Procedure:

I. Positioning of Rifle

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A. The rifle should be fired diagonally across the left side of the jeep, so that all adjustments may be made while standing on the ground.

B. Any cant in the system should be minimized by "digging in" the wheels of the jeep.

C. The M90C sight and the tube should be aligned on a common reference point on the target. A boresight case, and cross strings over the muzzle should be used. The sight must be cross-leveled during this operation. An allowance must be made for motion of the sight when tightening the locking nuts.

D. The quadrant should be positioned approximately at the center of the flat on the chamber. This position should be marked, and the quadrant returned to the same spot each time an adjustment is made. The boresight elevation (elevation when the line of sight through the bore coincides with the center of the target) should be measured and recorded. Since the reticle of the M90C sight is not graduated for the ammunition being tested, all elevations should be measured by the quadrant. They should be obtained by depressing rather than elevating the rifle.

E. The firing should be done remotely by a lanyard so attached that the rifle is not moved by the pull. This should be checked by "dry firing" several times while looking through the sight.

F. The velocity coils should be approximately 50 feet and 100 feet, respectively, from the muzzle. They must be so positioned that they do not obscure the target through the sight. Since the T119E12 projectile opens to approximately 11 inches in diameter, it must pass through the approximate center of each coil. The coil positions should be checked by sighting through the tube, and will probably have to be changed each time the deflection or elevation is changed. For this reason, it may be advisable, for the 1500 yard test, to fire one or two spotting rounds without taking velocities.

## II. Aligning and Firing the Rifle

A. Load the rifle and close the breech.

B. Align the rifle laterally by means of the sight, and vertically by means of the quadrant. Always approach the lateral reference point by traversing in the same direction, and obtain the elevation by depressing the rifle. The cross-level bubble on the sight must be centered during this operation. The alignment should be checked carefully before leaving the rifle.

C. Attach the lanyard and fire remotely.

D. By means of the B. C. scope, observe the projectile in flight, and note the location of impact.

E. After firing, check the sight for alignment with the bore. If misalignment occurs, and the deficiency cannot be corrected, replace the sight or sight mount or both. Such a check should be made frequently during the test.

F. If necessary, make adjustments to relocate the center of impact by changing the elevation or using a different vertical reference line on the target.

G. A group of approximately 15, T184E13 rounds and another group of approximately 15, T119E11 rounds should be fired at a 1000 yard target on the same day. Each round in a group should be fired at the same elevation and sight setting. Several rounds of one ammunition type will probably be needed as spotting rounds, which should not be included in the group, but whose location of impact should be measured. Using the other ammunition type for initial spotting, fire a group of each (total remaining rounds) at a 1500 yard target. Both the 1500 yard groups should be fired on the same day, which may be on a different day from the one of the 1000 yard firing. It is not advisable to attempt the 1500 yard firing if the wind velocity is over 10 mph and shifting. A steady wind may be compensated for.

### III. Recording of Data and Observations

A. Record the boresight elevation, super-elevation, and lateral deflection at which each round is fired. Suggested super-elevations for the spotting rounds are as follows: T184E13, 23 mils for 1000 yards and 41 mils for 1500 yards; T119E12, 25 mils for 1000 yards and 44 mils for 1500 yards.

B. Record the average wind velocity during the flight of each projectile, muzzle velocity for each, and average temperature during the firing period.

C. Observe the projectile in flight through the B. C. scope, and note any evidence of instability. Examine the imprints on the target for evidence of yaw, and for fin opening of the T119E12 projectile. Measure the location of each impact in such a way that it may be related to the aiming point. Each impact should be identified in the order of firing. It is suggested that measurements be made from the center of the target, rounds above and to the right indicated as positive, and rounds below and to the left indicated as negative.

D. The range from the muzzle to the target should be measured to the closest yard. The coil distances should be measured to the closest .01 ft. (top and bottom distances averaged) and a temperature correction for the tape recorded.

### IV. General

A. The ammunition should be stored without shelter, other than its own packaging, for whatever period of storage is required. The ammunition lot numbers, information on the weather conditions to which it has been subjected, including the range of temperature and relative humidity should be reported.

B. As the rounds are unpacked and fired, the general condition of the container and the ammunition should be noted and should include the following:

1. Ease of removal from the containers.
2. Condition of the moisture seal, and the positioning ring of the T184E13 round.
3. Ease with which the round is chambered, and the case extracted after firing. (Frequent light oiling of the breech will improve its functioning)
4. Condition of the cartridge case and primer after firing.

C. Should an erratic round be encountered during the test, every effort should be made to determine the cause, such as checking with the gunner for the possibility that the gun was not aligned properly, and examination of the area around the muzzle for evidence of projectile break-up.



D. The rifle should be observed for evidence of after-burning at the muzzle or breech, and accumulation of unburned propellant in the chamber.

E. In the event of a hang-fire or an obviously poor ignition, the sequence of events should be recorded as detailed as possible, i.e., the approximate time from the strike of the firing pin until the explosion, or the time of burning, the sound and the quantity, and color of smoke, should the propellant fail to explode.

F. In the event of a miss-fire the breech should be opened after a waiting period of 3 to 5 seconds. An attempt to fully close the breech after the trigger has been pulled may result in the rifle firing unexpectedly. The primer should be inspected to determine if it is too deeply seated in the case, and the rifle function fired. At least two more attempts to fire the round should be made. Miss-fires are quite frequently the fault of the weapon, and replacing the firing pin, or firing pin spring might eliminate the difficulty.

G. Care should be taken that the proper ammunition is used. The rounds for the 106mm rifle look almost exactly the same as the rounds for the 105mm rifle, and they could be fired from the 105mm rifle.

H. The accuracy of the groups should be expressed in terms of probable error in mils.

I. The general observations should include all aspects of the test and should be very detailed. These observations should be stated in the record even though many of them may appear to be of inconsequential importance.

J. Appropriate still and motion pictures will be taken of all phases of the test. Special attention will be given to all failures and unusual occurrences during the test.

K. An Envanal Chart will be completed at the end of the test and included in the formal report.

#### Instrumentation and Equipment Required:

Weapon, Mount, Sight, and Quadrant, mentioned under description of materiel, with spare sight and sight mount.

Plywood accuracy targets, 20 ft. square, marked off in three feet squares with lines that will be visible from the firing position, with timbers for bracing.

Thirty inch, velocity coils, with coil stands, wire and counter chronograph.

Anemometer, Thermometer, B. C. Scope

Spare parts for weapon such as sears, woodruff keys, firing pins, and firing pin springs.

Well equipped tool box, plus lanyard, boresight case, and squirt can of winter lubricating oil.

#### Ammunition Required:

40 ea., Cartridge, HEAT, Inert Projectile, T184E13, 105mm Rifle, M27, Counter-bored.

40 ea., Cartridge, HEAT, Inert Projectile, T119E12, 105mm Rifle, M27, Counter-bored.

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2

References:

Firing Record No. PS5424

Progress reports of Firestone Tire and Rubber Company on Battalion Anti-Tank Project  
Ordnance Department Project No. TAL-1540 (Ammunition), TS4-4020 (Weapon and  
Accessories).

Frankford Arsenal Report, Status Reports on Battalion Anti-Tank Weapon and Ammunition  
Projects TS4-4020, TAL-1540, TAL-1536

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APPENDIX C

FIRING RECORD NO. P 58702

CLIMATIC TEST DIVISION  
ABERDEEN PROVING GROUND, MARYLAND  
FIRING RECORD

OBJECT OF TEST: To compare the accuracy  
and ignition characteristics  
of the Cartridge,  
HEAT, T119E12 and the  
Cartridge, HEAT, T184E13  
under winter arctic con-  
ditions at Fort Churchill,  
Manitoba, Canada

DATE OF TEST: 13-22 February 1954  
FIRING RECORD NO. P 58702  
SHEET 1 OF  
AUTHORITY: Letter dated 25 August  
1953, OO 400.112/2772, APG 400.112/  
1496  
WORK ORDER NO. 962-40-02-3

DEVELOPMENT: ORDTA  
PROJECT NO: TB5-1401, TA1-1536  
RELATED FIRING RECORDS: NONE

TEST AMMUNITION

CARTRIDGE, HEAT, Inert, T184E13 for 105mm Rifle, M27, Lot  
No. PA-E-14055 composed of the following components:

CASE, Cartridge, T48E2, Lot No. PA-E-1274

PRIMER, Percussion, T82, Lot No. PA-E-14042

FUZE, Dummy, T208E7

PROPELLANT, M10, MP, .031 Web, Charge Weight, 7.9 pounds  
Lot No. PA-E-6101

IGNITION CARTRIDGE, (M50) T187, Boom, Lot No. PA-E-12667

IGNITION CARTRIDGE, (M49) T186, Tail, Lot No. PA-E-13126

CARTRIDGE ASSEMBLY, 105mm, T184E13, Lot No. PA-E-1606  
Shell inert loaded with 70% PCN, 10% Celite, and  
20% Iron Oxide

NITROCELLULOSE Liner

CARTRIDGE, HEAT, Inert, M343 (T119E12) with Fuze, Dummy, T208E7  
for 105mm Rifle, M27, Lot No. PA-E-14178 composed of the following  
components:

CASE, Cartridge, T53E2, 105mm, Lot No. F4 lot 42

PRIMER, Percussion, M57, Lot No. LS-13-14

LINER ASSEMBLY, T4E1

FIN ASSEMBLY, T14

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FIRING RECORD NO: P 58702  
SHEET 2 OF

SHELL, 105mm, T119E12, inert loaded to 17.52 lbs. Lot No. 3

FUZE, Dummy, T208E7

PROPELLANT, M10, .031 web, charge weight 7 lbs. 12 ounces,  
Lot No. PA-E-6101

MATERIEL

105MM, M27, Counterbored, Recoilless Rifle, No. 80 mounted on  
Truck, 1/4 Ton, M38

MOUNT, Rifle, 105mm, M75, No. 45

TELESCOPE, M90D, No. 5570

MOUNT, Telescope, M3A1E1, No. 2

FACILITIES

Battery commander's telescope

Two Skyscreens

Counter Chronograph

M5 Generator

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FIRING RECORD NO: P 58702  
SHEET 3 OF

ROUND BY ROUND DATA

ACCURACY TEST, T119E12, 1008 YARD RANGE

WIND VELOCITY: 10 MPH  
WIND DIRECTION: W  
TEMPERATURE: -26°F

DATE: 13 February 1954  
FIRING POSITION: D  
DIRECTION OF FIRE: 310°P  
BORESIGHT ELEVATION: 3 MILS

TEST SAMPLE NO.	TUBE ROUND NO.	TIME OF FIRING	IMPACT LAT FT.	COORDINATES VERT FT.	FIN SPREAD INS.	TOTAL ELEVATION MILS	REMARKS
C/R	237		8.2	2.3	10 $\frac{1}{2}$	25	
C/R	238			Low		25	
C/R	239		3.8	1.0	10 $\frac{1}{2}$	28	
C/R	240	1525		Low		28	
1	241		6.25	6.05	10-5/8	30	
2	242		3.6	3.65		30	
3	243		2.1	3.76	10-3/8	30	
4	244		5.75	6.95	10-5/8	30	
5	245		5.00	3.8		30	
6	246		4.1	5.35	10 $\frac{1}{2}$	30	
7	247		5.35	3.9		30	Impact revealed rnd yawing
8	248		6.7	5.3	10-3/8	30	
9	249		6.2	4.0	10-3/4	30	
10	250		4.9	2.85	10-7/8	30	Impact revealed rnd yawing
11	251		5.1	7.5	10-5/8	30	
12	252		4.9	5.2	10-5/8	30	
13	253		4.15	2.05	10-5/8	30	
14	254		4.3	3.6		30	
15	255		4.00	3.8		30	
16	256	1600	4.6	3.4		30	

REMARKS

1. All impact measurements made from left and bottom edges of 12' X 12' target.
2. All velocities were lost because of a malfunction of the skyscreens.
3. Gun was boresighted on left top corner of target.

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FIRING RECORD NO: P 58702  
SHEET 4 OF

ACCURACY TEST, T184E13 -1008 YARD RANGE

WIND VELOCITY: 6 MPH  
WIND DIRECTION: NW  
TEMPERATURE: -19°F

DATE: 14 February 1964  
FIRING POSITION: D  
DIRECTION OF FIRE: 310°  
BORESIGHT ELEVATION: 3 MILS

TEST SAMPLE NO	TUBE ROUND NO	TIME OF FIRING	IMPACT LAT INS	COORDI- NATE VERT INS	MUZZLE VELOCITY FPS	MUZZLE AFTER BURNING LGTH FEET	POSITION- ING RING CONDITION	LINER CONDI- TION	REMARKS
C/R	257	1435	39	66.5	1541	1	C	C	
C/R	258		38	82	1521	1	C		
1	259		34	56	1527	1	S	C	
2	260		30	50	1527	1			
3	261		54	46	1528	2		C	
4	262		28.5	7.5	1513	1		C	
5	263		32.5	36	1538	1	C	P	
6	264		33	38	1499	1	C		
7	265		2	76	1515	2			Target Fell
8	266		21	66	1511	1		P	
9	267		46.5	16	1516	2	C		
10	268		40.5	0	1497	1			
11	269		28	69	1517	1			
12	270		79	49.5	1522	1		C	
13	271		64	43.5	1515	1	S		
14	272		66	49	1521	1			
15	273		30	51	1529	1	C	P	
16	274		107	71	1528	1			
17	275		53	39	1512	2	C	C	
18	276	1600	27	56.5	1531	1		C	

REMARKS

1. The total elevation of the tube throughout the test was 28 mils.
2. On test sample round number 7, the left target upright was hit causing the target to fall. The target was re-erected and the test continued.
3. The "C" under positioning ring condition and liner condition indicates that the particular liner or ring was cracked. The "S" under positioning ring condition indicates a shattered ring and the "P" under liner condition indicates a peeling liner which was exposing the case perforations.
4. All impact measurements were made from the bottom and left side of the target. The gun was boresighted on the left top corner of the 12' X 12' target.

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FIRING RECORD NO: P 58702  
SHEET 5 OF

ACCURACY TEST, T184E13, 1508 YARD RANGE

WIND VELOCITY: CALM  
WIND DIRECTION: -  
TEMPERATURE: -10°F

DATE: 17 February 1954  
FIRING POSITION: D  
DIRECTION OF FIRE: 310°  
BORESIGHT ELEVATION: 1.6 MILS

TEST SAMPLE NO.	TUBE ROUND NO	TIME OF FIRING	IMPACT LAT FT	COORDI- NATES VERT FT	MUZZLE AF- TER BURN- ING LGTH FT	POSITION- ING RING CONDITION	LINER CONDI- TION	MUZZLE VELOCITY FPS	TOTAL ELEVATION MILS
C/R	277	1510	Left	Low	1			1509	48
C/R	278		Left		1	C		1540	48
C/R	279		Left		1			1533	48
C/R	280		Left	Low	1	C	C	1530	48
C/R	281		Miss		1			1521	47
1	282		10.9	7.3	1	S		1536	48
2	283		12.4	4.4	1		C	1526	48
3	284		14.7	6.1	2		P	1526	48
4	285		7.9	13.55	1	C		1517	48
5	286		10.4	10.4	1	C	C	1526	48
6	287		5.9	9	1			1523	48
7	288		10.1	11.3	1	S	C	1522	48
8	289		6.1	14.65	1			1514	48
9	290			Low	2	C		1497	48
10	291		6.9	16.9	1			1510	48
11	292		6.75	13.65	1	C		1511	48
12	293		6.3	11.5	1	C		1515	48
13	294		9.6	14.45	1	C		1509	48
14	295		8.4	14.6	1			1512	48
15	296	1545	11.7	16.2	1	C		1500	48

REMARKS

1. The "C" under liner condition and positioning ring condition indicates that the particular liner or ring was cracked. The "S" under positioning ring condition indicates a shattered ring and the "P" under liner condition indicates a peeling liner which was exposing the case perforations.

2. All impact measurements were made from the top and left of the 18 foot high by 20 foot wide cloth target.

3. The gun was boresighted at the top left corner of the target.

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ACCURACY TEST, T119E12, 1508 YARD RANGE

FIRING RECORD NO: P 58702  
SHEET 6 OF

WIND VELOCITY: 8 MPH  
WIND DIRECTION: SW  
TEMPERATURE: -12°F

DATE: 22 February 1964  
FIRING POSITION: D  
DIRECTION OF FIRE: 310°  
BORESIGHT ELEVATION: 1.6 MILS

TEST SAMPLE NO	TUBE ROUND NO	TIME OF FIRING	IMPACT COORDI - LAT FT NATES VERT FT	MUZZLE VELOCITY FPS	TOTAL ELEVATION MILS	REMARKS
C/R	297			1546	48	Missed target
C/R	298			1553	48	Missed target
C/R	299	1050		1546	50	Missed target
C/R	300			1530	52	Missed target
1	301		4.2 6.0	1557	52	
2	302		5.4 2.3	1540	52	
3	303		3.5 1.3	1538	52	
4	304		6.9 1.5	1558	52	
5	305		9.3 13.6	1534	52	
6	306		0 8.4	1562	52	Hit upright, target fell
7	307		5.8 3.5	1536	52	
8	308		High	1517	52	
9	309	1415	2.1 3.8	1564	52	
10	310		3.9 2.0	1575	52	
11	311		High	1554	52	
12	312		High	1541	52	
13	313		High	1558	52	
14	314		High	1563	52	
15	315		High	1548	52	
16	316	1430	High	1533	52	

#### REMARKS

1. All impact measurements were made from the left and top of the 18 foot high by 20 foot wide cloth target.

2. Test sample round six hit one of the target supports causing the target to fall.

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FIRING RECORD NO: P 58702  
SHEET 7 OF

SUMMARY

	T119E12 1008 Yd Range	T119E12 1508 Yd Range	T184E13 1008 Yd Range	T184E13 1508 Yd Range
Number of rounds fired in accuracy pattern <del>not</del> includ- ing conditioning rounds	16	16	18	15
Number of rounds which missed target in accuracy pattern not including conditioning rounds	0	7	0	1
Probable Error				
Vertical (MILS)	.333	.456	.387	.573
Lateral (MILS)	.257	.305	.453	.401
Average Velocity (FPS)	-	1548	1519	1516
Maximum velocity dispersion between rounds (FPS)	-	37	41	39

APPROVED BY:

A. B. DUKE  
LT COL, ORD CORPS  
Chief, Climatic Test Division  
Development & Proof Services

*R. E. Engelhardt*  
R. E. ENGELHARDT  
PROJECT ENGINEER

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APPENDIX D  
DATA REDUCTION ANALYSIS

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HMaisel/mkh/21134

SUBJECT: Cold Weather Accuracy Comparison of Firings of the  
Tl84 Type and Tl19 Type Projectiles

1. At the request of Mr. Englehardt of the Southwest Institute, the Analytical Section has made an analysis of the cold weather accuracy firings described in firing records P-58702 and P-58703. These firings were conducted at Fort Churchill, Canada, during the period 13-24 Feb 54. The results obtained are summarized in Table I.

2. These results do not conclusively establish which projectile is more accurate because too few rounds were fired and because of the loss of information due to technical difficulties encountered during these firings (See footnotes to Table I for a description of these difficulties). The accuracy results do suggest the possible superiority of the Tl19 type projectile; but this conclusion cannot be accepted unless it is verified by further firings. It should be noted that the misses occurring at the 1500 yard range with the Tl84E12 and the Tl19E12 projectiles were ascribed to adverse test conditions rather than poor accuracy of the projectiles.

3. A number of the Tl84 rounds fired for accuracy had cracked or shattered positioning rings. Probable errors were calculated including only those Tl84 rounds having damaged positioning rings and also only for those Tl84 rounds with undamaged rings. It was found that the Tl84E13 rounds having damaged rings gave better accuracy than those rounds with undamaged rings. No conclusion regarding the effect of damaged rings on accuracy firings with the 106mm Rifle can be made since only four Tl84E12 rounds fired at the 1008 yard range and one Tl84E12 round fired at the 1508 yard range had damaged positioning rings. However, the results with the Tl84E13 rounds are sufficient to indicate that if the Tl84 type projectile does have poorer accuracy than the Tl19 type, this difference might not be related to the condition of the positioning rings.

4. Combined effects, such as that of rifle and projectile or date of firing and projectile, could not be determined because of the small number of rounds fired per target and the variation from target to target in the size of the accuracy group.

3 Incls.

1. Two (2) Tables
2. Two (2) Charts
3. Two (2) Firing Records

J. E. STEEDMAN

Propellant & Target Accuracy Unit  
Arms and Ammunition Division

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TABLE I

## Vertical Target Accuracy Results

Rifle	Range (yds)	Projectile	Date Fired	No. Rds. Fired	No. Rds. Missing Target	Probable Error (mils)	
						Vertical	Lateral
106mm T17031	1008	T119311	23 Feb 54	10	0	.37	.35
		T184312	24 Feb 54	17	2a	.49	.30
1508	1508	T119311	23 Feb 54	11	1	.30d	.24d
		T184312	23 Feb 54	16	4b	.39	.41
105mm M27	1008	T119312	13 Feb 54	16	0	.33	.26
		T184313	14 Feb 54	18	0	.39	.45
1508	1508	T119312	22 Feb 54	16	7c	.61	.40
		T184313	17 Feb 54	15	1	.57	.40

a. Center of Impact of those rounds hitting the target was 42.2" from the left edge and 51.4" from the bottom of the target. One of the misses was noted as low.

b. There appeared to be a shift in elevation after Rd. 6. The Center of Impact of those rounds hitting the target was 47.9" from the bottom of the target. The Center of Impact of the first six rounds was 62.6" from the bottom of the target. All four rounds that missed were short and were among the last ten rounds fired. The Center of Impact of the remaining six of the last ten rounds fired was 33.2" from the bottom of the target. However, the Vertical P.E. of the first six rounds alone is .49 mils.

c. The target fell after the sixth round was fired and after it was erected again, seven of the last ten rounds fired went over the target. The Vertical Center of Impact of the three rounds hitting the target was 37.2" from the top of the target.

d. P.E.'s include one round which misfired initially and fired on the second attempt. Omitting this round, the Lateral P.E. is .12 mils.

Anal Sect, A&A Div, D&PS  
2 Dec 54 HM

TABLE 3 II  
 Probable Errors of Impacts of Rounds with Damaged and of Rounds with Undamaged  
 Positioning Rings

<u>Rifle</u>	<u>Projectile</u>	<u>Range (yds)</u>	<u>Condition of Positioning Rings</u>	<u>No. Rds.</u>	<u>Probable Error (mils)</u>	
					<u>Vertical</u>	<u>Lateral</u>
105mm	T184E13	1008	Damaged	7	.24	.24
			Undamaged	11	.46	.56
105mm	T184E13	1508	Damaged	8	.41	.29
			Undamaged	6	.77	.55
106mm	T184E12	1008	Damaged	4	.65(.14)*	.32
			Undamaged	11	.45	.31

\* P.E. omitting 1 round.

Anal Sect, A&A Div, D&PS  
 2 Dec 54 HM

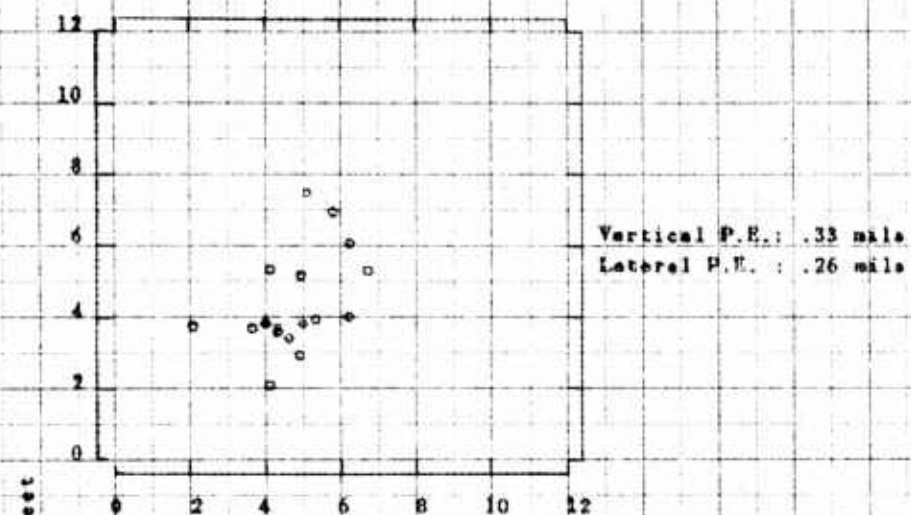
35

VERTICAL TARGET ACCURACY OF CARTRIDGES HEAT T119E12 & T184E13  
FIRED IN THE 105MM RIFLE M27, NO. 80

HEAT T119E12

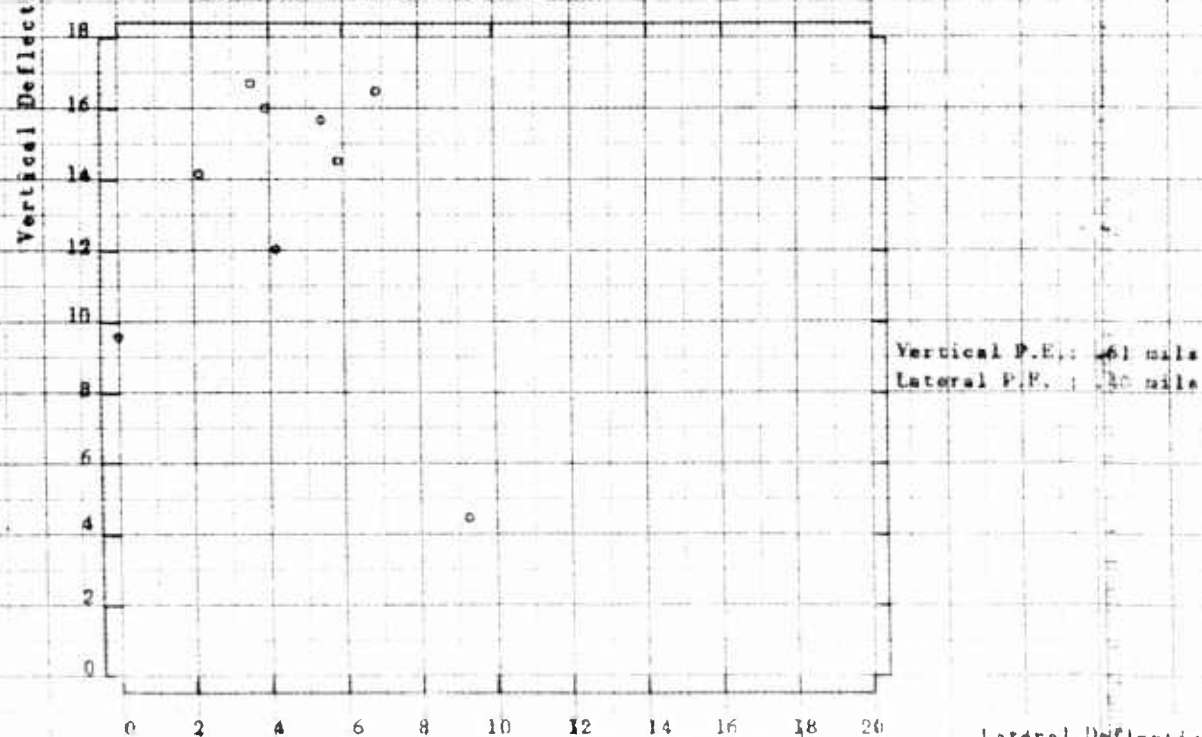
RANGE: 1008 YDS

DATE OF FIRING: 13 FEB 54



RANGE: 1508 YDS

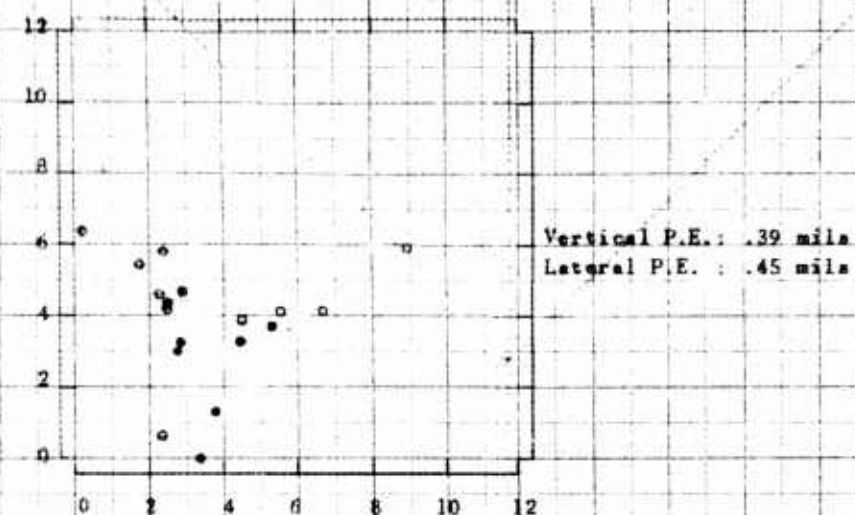
DATE OF FIRING: 22 FEB 54



HEAT T184E13

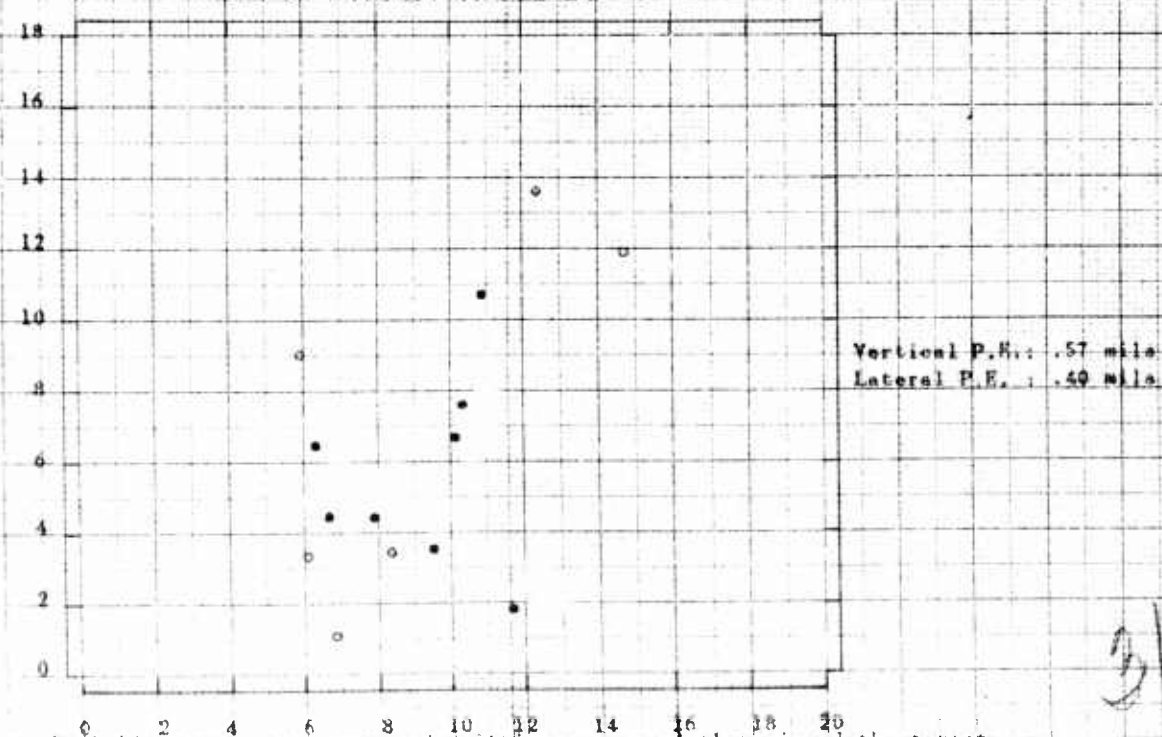
RANGE: 1008 YDS

DATE OF FIRING: 14 FEB 54



RANGE: 1508 YDS

DATE OF FIRING: 17 FEB 54



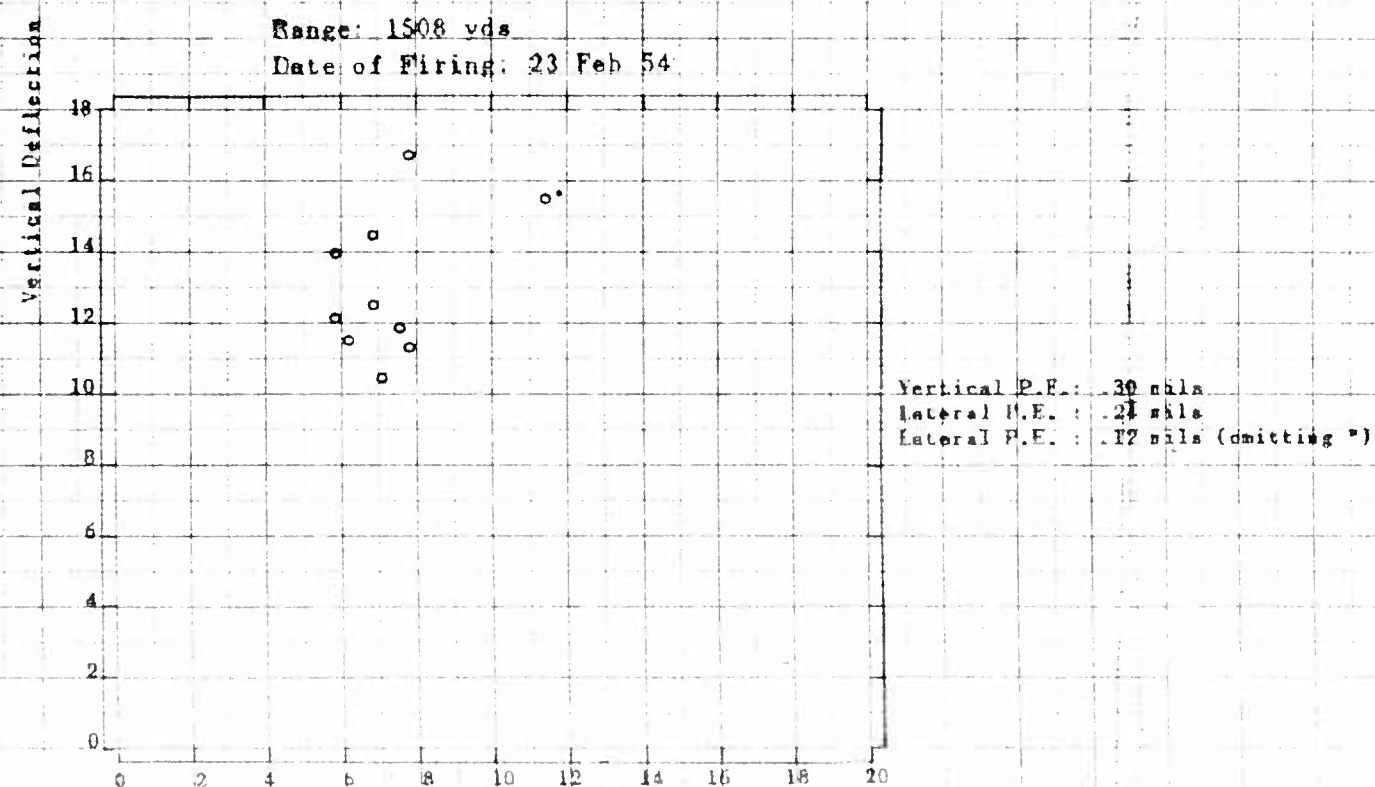
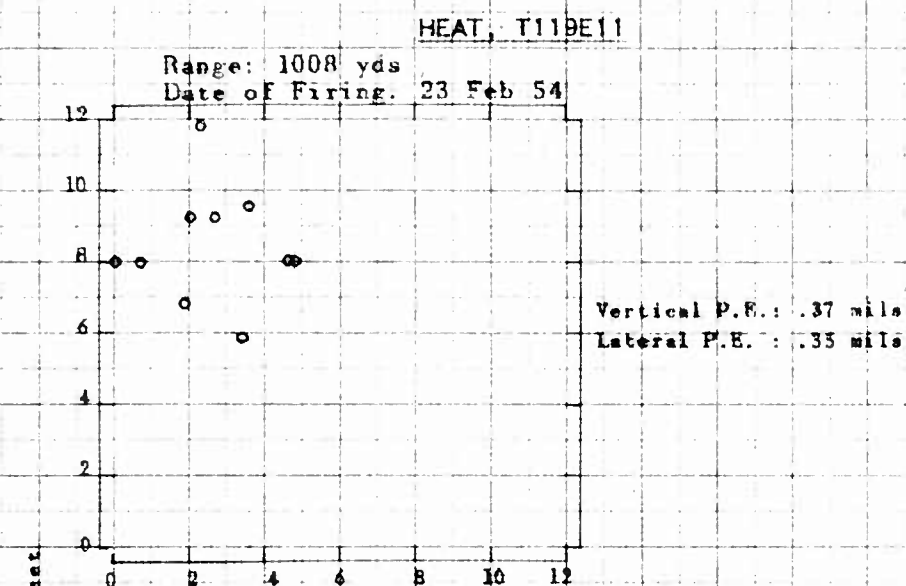
Probable errors were computed omitting seven rounds that missed the target (see attached Table I, footnote (1))

Probable errors were computed omitting one round that missed the target  
Anal Sect, AAA Div, D&PS  
17 Nov 54 JRS

• THESE ROUNDS HAD DAMAGED POSITIONING RINGS

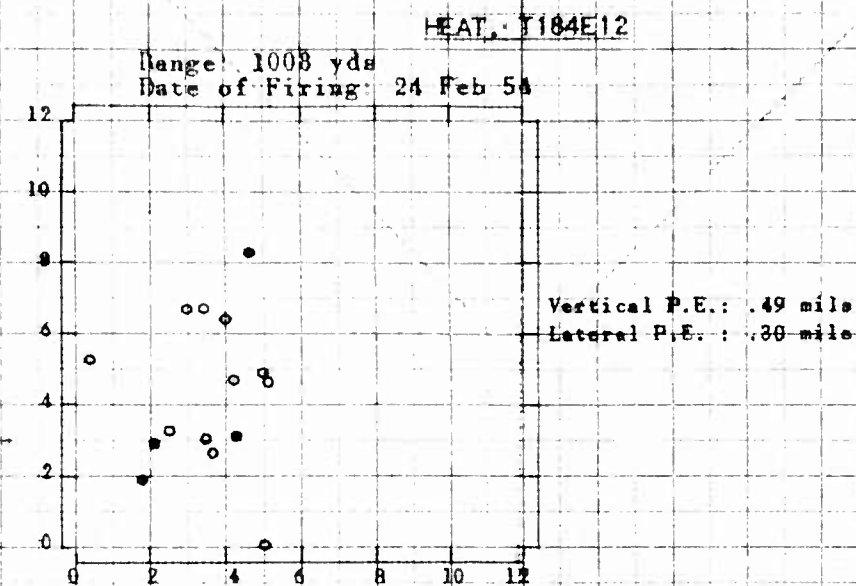


VERTICAL TARGET ACCURACY OF CARTRIDGES HEAT T119E11 & T184E12  
FIRED IN THE 106MM RIFLE T170E1, NO. 3

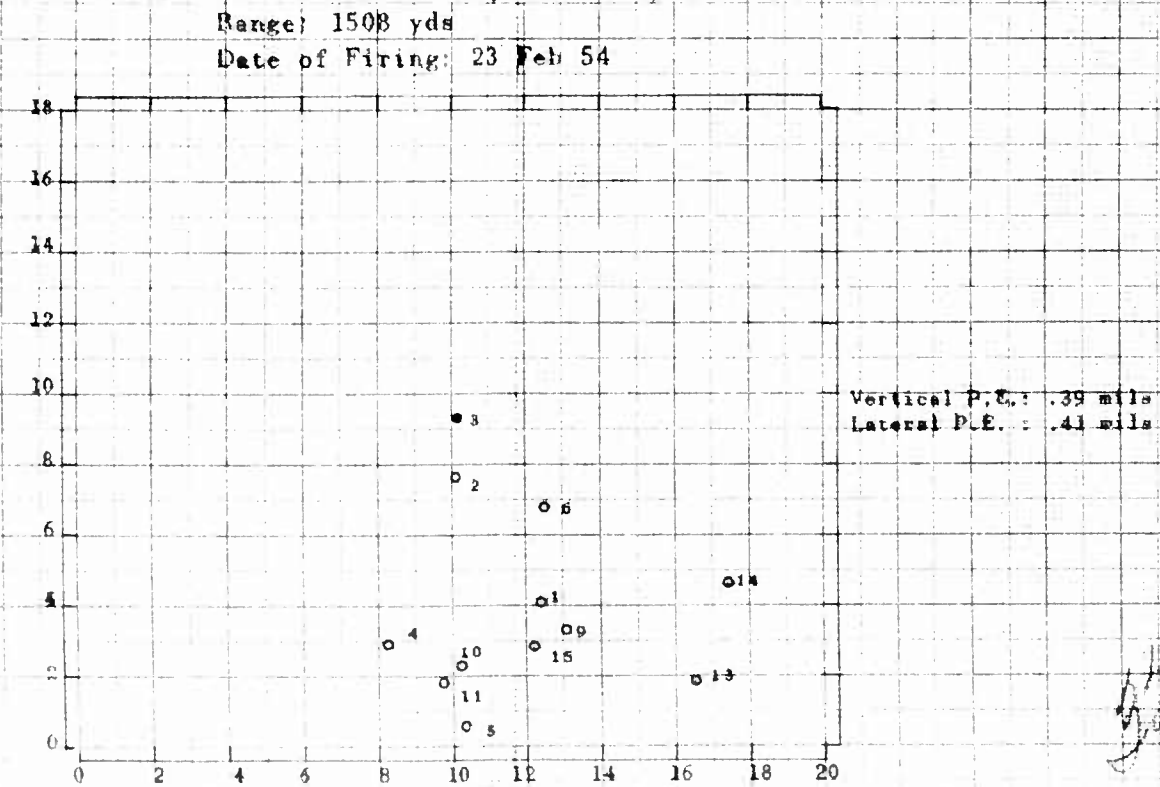


Probable errors were computed omitting one round that missed the target.

• THESE ROUNDS HAD DAMAGED POSITIONING RINGS.



Probable errors were computed omitting two rounds that missed the target (see attached Table I, footnote A)



Probable errors were computed omitting four rounds that missed the target (see attached Table I, footnote B)

Anal Sect, A&A Div, D&PS  
1 Dec 54 JES



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APPENDIX E  
WEATHER DATA

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# WEATHER DATA

All rounds were stored in an exposed location in fiber containers and packed two to a wooden crate.

The date of arrival at Fort Churchill of the T184E13 round was 13 February and 9 February for the T119E12 round. The following table indicates the daily temperature extremes to which the rounds were subjected.

DATE FEBRUARY	MAXIMUM RELATIVE HUMIDITY PERCENT	MAXIMUM TEMPERATURE DEGREES F	MINIMUM TEMPERATURE DEGREES F
9	95	2	-14
10	78	-13	-23
11	70	-13	-21
12	78	-6	-22
13	58	-22	-32
14	65	-19	-29
15	72	-23	-37
16	77	-10	-29
17	86	-8	-21
18	78	-5	-13
19	83	0	-13
20	90	-3	-25
21	95	-16	-26
22	75	-2	-24
23	87	4	-5
24	95	2	-16
25	95	1	-21

# RECORD OF EQUIPMENT PERFORMANCE

Source for Rating - 143rd Report on Project TB5-1401

Item of Equipment: Shell, HEAT, 105mm, T18LE13

Rated by: R. E. Engelhardt Date: 25 May 1954

	RATING	SOURCE	REMARKS
Durability			
<u>ENVIRONMENTAL FACTOR</u>			
Hard Surface Road			
Gravel Surface Road			
Unsurfaced Trail			
rough Hard Ground			
Stony or Rocky Ground			
Sand (dry)			
Loose Sand (shallow water)			
Clay (wet)			
Muskeg (frozen)			
Muskeg (unfrozen)			
Frozen Ground			
Hilly or Mountainous			
Swamp			
Smooth Ice			
Rough Ice			
Pack Ice			
Hard Packed Snow			
Dry Snow, Powdery to 18"			
Dry Snow, Powdery over 18"			
Dry Snow, Compacted to 18"			
Dry Snow, Compacted over 18"			
Wet Snow			
Water less than 2' depth			
Water to 5' depth			
Water over 5' depth			
Temp. below -65°F.(storage)			
Temp. from -65°F. to -25°F.			
Temp. from -25°F. to +32°F.	1		Accuracy Satisfactory at 1000 and 1500
Temp. from +32°F. to +90°F.			Yard Ranges
Temp. from +90°F. to +125°F.			
Temp. over +125°F.			
Radiation, to 360 BTU/Ft.Sq./Hr.			
Dust, Airborne			
Blowing Sand			
Blowing Snow			
Rain			
Snowfall, Heavy			
Ice Fog			
Sleet (freezing)			
Wind (over 25 mph)			
Altitude to 5,000'			
Altitude over 5,000'			
Tropical Humidity			
Forest (open)			
Brush (dense)			
Tundra (unfrozen)			
Windchill (700 to 1400)			
Windchill (1400 to 1900)			
Windchill (over 1900)			

A

# **RECORD OF EQUIPMENT PERFORMANCE**

Source of Rating - 143rd Report on Project TB5-1401

Item of Equipment: Shell, HEAT, 105mm, T119E12

Rated by: R. E. Engelhardt

Date: 25 May 1954

	RATING	SOURCE	REMARKS
<b>Durability</b>			
<b><u>ENVIRONMENTAL FACTOR</u></b>			
Hard Surface Road			
Gravel Surface Road			
Unsurfaced Trail			
Rough Hard Ground			
Stony or Rocky Ground			
Sand (dry)			
Loose Sand (shallow water)			
Clay (wet)			
Muskeg (frozen)			
Muskeg (unfrozen)			
Frozen Ground			
Hilly or Mountainous			
Swamp			
Smooth Ice			
Rough Ice			
Pack Ice			
Hard Packed Snow			
Dry Snow, Powdery to 18"			
Dry Snow, Powdery over 18"			
Dry Snow, Compacted to 18"			
Dry Snow, Compacted over 18"			
Wet Snow			
Water less than 2' depth			
Water to 5' depth			
Water over 5' depth			
Temp. below -65°F. (storage)			
Temp. from -65°F. to -25°F.			
Temp. from -25°F. to +32°F.	1	1	Accuracy Satisfactory at 1000 Yards
Temp. from +32°F. to +90°F.			
Temp. from +90°F. to +125°F.			
Temp. over +125°F.			
Radiation, to 360 BTU/Ft.Sq./Hr.			
Dust, Airborne			
Blowing Sand			
Blowing Snow			
Rain			
Snowfall, Heavy			
Ice Fog			
Sleet (freezing)			
Wind (over 25 mph)			
Altitude to 5,000'			
Altitude over 5,000'			
Tropical Humidity			
Forest (open)			
Brush (dense)			
Tundra (unfrozen)			
Windchill (700 to 1400)			
Windchill (1400 to 1900)			
Windchill (over 1900)			

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APPENDIX G

PHOTOGRAPH

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A96304

8 ABERDEEN PROVING GROUND 8 10 February 1954

WINTER TEST 1953-54, FORT CHURCHILL, MANITOBA, CANADA  
 Project No. TB5-1401/143. Winter Test, 1953-54. Comparing Cartridge  
 T119E12 and T184E13. A comparison of arctic and conventional gloves  
 while using the firing handle of the 105mm Recoilless Rifle, M27.



A96305

8 ABERDEEN PROVING GROUND 8

10 February 1954

WINTER TEST 1953-54, FORT CHURCHILL, MANITOBA, CANADA  
Project No. TB5-1401/143. Winter Test, 1953-54. Comparing Cartridge  
T119E12 and T184E13. Recoilless Rifle, 105mm, M27, mounted on 1/4-ton  
Truck, emplaced at firing position.



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8 ABERDEEN PROVING GROUND 8

10 February 1954

WINTER TEST 1953-54, FORT CHURCHILL, MANITOBA, CANADA  
Project No. TB5-1401/143. Winter Test 1953-54. Comparing Cartridge  
T119E12 and T184E13. Damage to T184 type Cartridge support ring  
incurred during shipment and handling.



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